

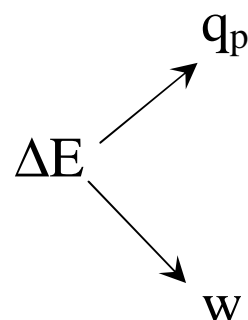
$$\Delta E = q + w \quad \text{closed system}$$

- thermodynamic potential
- ability to transfer heat or do work
- energy is conserved
- the only way to change the internal energy of a closed system is through transfers of heat and work
- the internal energy of the universe is constant

$$\Delta E = q - \underbrace{P \Delta V}_w \quad (\text{expansion work only})$$

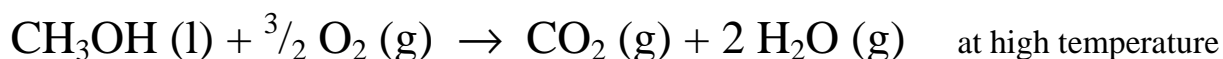
$$\text{cst. } V: q_v = \Delta E$$

$$\text{cst. } P: q_p = \Delta E + \underbrace{P \Delta V}_{-w}$$



define for convenience: $\Delta H = \Delta E + P \Delta V$

$$q_p = \Delta H$$



gases do work as they push back the atmosphere, decreasing the available heat transfer